Critical Care

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Aggressive therapies for intracranial hypertension after aneurysmal subarachnoid hemorrhage: a single-center experience

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To the editor,

Intracranial hypertension (HICP) is a frequent cerebral insult after aneurysmal subarachnoid hemorrhage (SAH) and it is related to unfavorable outcome [1]. Its treatment is based on escalating-intensity approaches, translated from traumatic brain injury, including aggressive therapies such as barbiturate infusion, secondary surgical decompression and/or intracerebral hemorrhage (ICH) evacuation, hypothermia and hypocapnia [1, 2]. However, there is limited data about these therapies after SAH and their impact on the patient's outcome [1, 3]. The aims of this study, based on a single-center experience, were: (1) to describe how frequently HICP requires aggressive therapies after SAH; (2) to explore clinical and radiological factors related to the need for these therapies; (3) to analyse the relationship between aggressive therapies and the patient's outcome.

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Methods

We examined a prospective observational database including aneurysmal SAH adult patients requiring ICP monitoring and admitted to the neuro-ICU of our hospital.

Patients were managed as previously described [4]. In our center, ICP after aneurysmal SAH is monitored in severe, comatose patients and/or cases with acute hydrocephalus requiring external ventricular drain placement. The mean ICP for 12-h intervals was calculated and indicated as "mean ICP". The highest mean ICP and episodes of HICP (ICP > 20 mm Hg for at least 5 min) were noted for each patient.

Therapeutic intensity was assessed twice a day. Therapies for HICP were classified as:

(1) Preventive: normocapnia and sedation in ventilated patients, avoidance of pyrexia.
(2) Active: cerebrospinal fluid (CSF) withdrawal through an external ventricular catheter, mild hypocapnia (arterial pCO_2 30–35 mmHg), hyperosmolar fluid and muscle relaxants.
(3) Aggressive: reinforced hypocapnia (pCO_2 less than 30 mmHg), barbiturates (continuous thiopentone infusion), hypothermia (endovascular or surface cooling to maintain temperature below 36 °C), secondary ICH evacuation and/or surgical decompression (done more than 24 h after ICU admission).

Six-month Glasgow Outcome Scale (GOS) scores 1–3 were considered unfavorable, scores 4–5 as favorable.

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Univariate analysis followed by a logistic regression model were used to identify clinical and radiological factors related to aggressive therapies using the stepwise method.

Results

Six hundred eighty-two adult patients with aneurysmal SAH were consecutively admitted to the ICU between 2006 and 2020. Two hundred thirty-six patients were included in the analysis while 446 were excluded because ICP was not monitored. The main clinical and radiological findings are summarized in Table 1. Sixty patients out of 236 (25%) required at least one aggressive therapy. All these patients received ICP preventive treatments and at least one standard therapy. Thirty-five patients received one aggressive therapy, 15 received two and 10 received three. In this group of patients, reinforced hypocapnia was used in 86% of cases, secondary surgical therapy in 37%, barbiturate and hypothermia in 11%. The median time of first aggressive treatment ranged from day 1 after ICU admission to day 3. In the logistic regression model, only severe neurological status, age, midline shift, aneurysm treatment and highest mean ICP > 20 mmHg were significantly related with aggressive therapies. Patients

Table 1 Characteristics of patients requiring and not requiring aggressive therapies

	Aggressive therapies	No aggressive therapies	*p* value*
	(n = 60)	(n = 176)	
Age (mean; SD)	53.2(12)	59.7 (12.9)	$p < 0.001$
Female (n, %)	39 (65%)	129 (73%)	$p > 0.05$
Fisher score			$p > 0.05$
1 (n, %)	0	1 (0.5%)	
2 (n, %)	2 (3.3%)	8 (4.5%)	
3 (n, %)	38 (63.3%)	127 (72%)	
4 (n, %)	20 (33.3%)	40 (23%)	
ICH (n, %)	38 (63%)	73 (41.5%)	$p < 0.001$
Midline Shift (n, %)	22 (37%)	22 (12.5%)	$p < 0.001$
Aneurysm site			$p > 0.05$
Anterior (n, %)	50 (83%)	140 (79.5%)	
Posterior (n, %)	10 (17%)	36 (20.5%)	
Aneurysm treatment			$p < 0.001$
Clip (n, %)	24 (40%)	33 (19%)	
Coil (n, %)	36 (60%)	140 (81%)	
Intraoperative complications (n, %)	32 (53%)	78 (45%)	$p > 0.05$
Primary surgery** (n, %)	22 (37%)	29 (16%)	$p < 0.01$
WFNS			$p < 0.001$
Mild (1–3) (n, %)	3 (5%)	49 (28%)	
Severe (4–5) (n, %)	57 (95%)	127 (72%)	
Rebleeding (n, %)	31 (52%)	65 (37%)	$p < 0.05$
Clinical vasospasm (n, %)	16 (27%)	53 (30%)	$p > 0.05$
Episodes of HICP (n, %)	58 (97%)	128 (73%)	$p < 0.001$
Highest mean ICP > 20 mmHg (n, %)	44 (73%)	41 (23%)	$p < 0.001$
ICU mortality (n, %)	21 (35%)	19 (11%)	$p < 0.001$
6-month GOS****			$p < 0.01$
Favorable (n, %)	8 (14%)	55 (35%)	
Unfavorable (n, %)	50 (86%)	104 (65%)	

Six hundred eighty-two adult patients with aneurysmal SAH were consecutively admitted to the ICU between 2006 and 2020. ICP was monitored in 236 patients and they were included in the analysis (446 patients were excluded because ICP was not monitored). Legend: ICH: intracerebral haemorrhage; WFNS: World Federation of Neurological Surgeons scale; GOS: Glasgow Outcome Scale

*Univariate analysis

**ICH evacuation and surgical decompression were considered primary surgery if done within 24 h from ICU admission

***Including suspected bleeding indicated by abrupt neurological deterioration before hospital admission

****Nineteen patients were lost to follow-up

in the aggressive therapies group had higher mortality in the ICU and six-month unfavorable outcomes.

Conclusion

In our experience, even though HICP episodes are frequently detected after SAH, multiple aggressive therapies (and their side-effects) do not seem necessary in the majority of patients.

Patients submitted to aggressive therapies were more severe and younger than cases treated less intensively. In our center HICP management is guided by data from ICP monitoring, clinical and radiological evaluations. Therefore, a link between severity and the use of aggressive therapies is not unexpected. The relationship with age could have two explanations: elderly subjects may have a lower incidence of HICP than younger patients due to cerebral atrophy and greater CSF space. On another hand, older age is strongly related to unfavorable long-term outcome: aggressive therapies might be considered futile in elderly patients.

Our work has an important limitation. This is a single-centre observational study in selected patients, so any generalization calls for caution. In the recent large observational multicenter trial SYNAPSE-ICU, aggressive therapies were considered in 29% of patients with SAH but there were considerable differences between countries and centers [5]. The rate of favorable outcome in the aggressive therapies group is extremely low and therefore an appropriate patient selection seems indispensable.

Abbreviations

SAH	Subarachnoid haemorrhage
ICP	Intracranial pressure
HICP	Intracranial hypertension
ICU	Intensive care unit
ICH	Intracerebral haemorrhage
CT	Computed tomography
CSF	Cerebrospinal fluid
GCS	Glasgow Coma Scale
WFNS	World federation of neurological surgeons scale
GOS	Glasgow outcome scale

Author contributions

TZ, EZB and NS conceived and designed the study. EZB, TZ, FO, VC, SP, AM, ML and AZ contributed to data collection, analysis and interpretation. TZ, EZB, AZ, ML, FO and NS critically revised the manuscript.

Funding

This study was partially supported by the Italian Ministry of Health (Bando Ricerca Finalizzata 2019: GR-2019-12369998 and Bando Ricerca Corrente).

Availability of data and materials

The datasets used and analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

This study was approved by the local ethics committee (Comitato Etico Territoriale Lombardia 3).

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Received: 30 October 2024 Accepted: 5 December 2024
Published online: 18 December 2024

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